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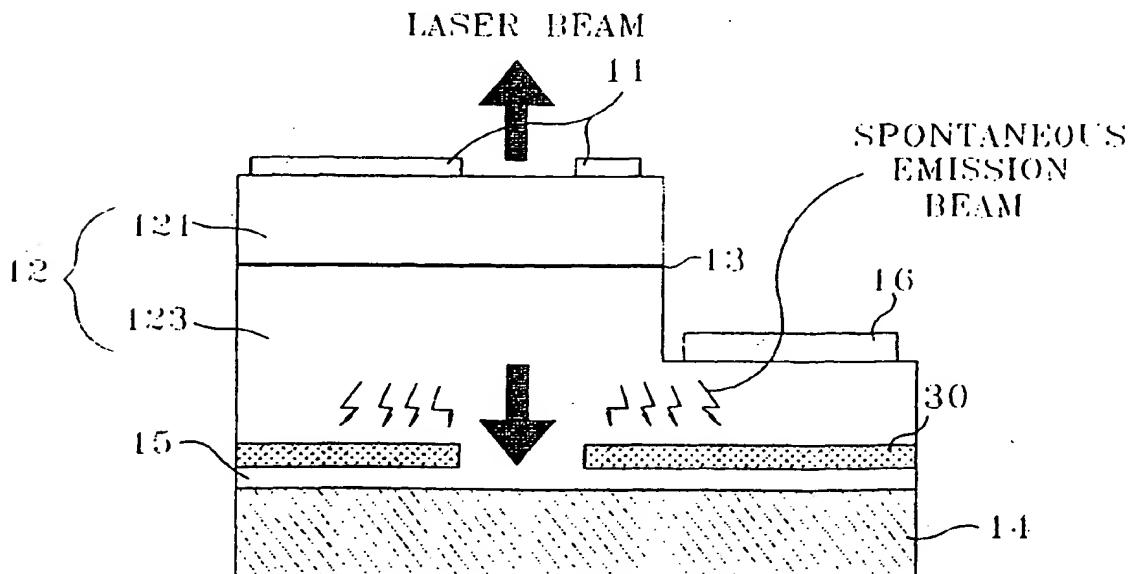
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### (54) Surface laser diode package having an optical power monitoring function

(57) A surface laser diode package having an optical power monitoring function for a surface laser beam, the surface laser diode package comprising: a substrate (14); a surface laser diode (12) for making a spontaneous emission beam generated from an active region oscillate by means of an upper mirror (121) and a lower mirror (123), and emitting a surface laser beam obtained by the oscillation; and a monitor diode (15), installed be-

tween the substrate (14) and the lower mirror (123) of the surface laser diode (12), for performing a light detection operation with respect to the surface laser beam emitted toward the substrate via the lower mirror (123), in order to monitor the optical power of the surface laser diode (12). The surface laser diode package can accurately monitor the optical power of the surface laser diode (12).

FIG. 3



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### Description

The present invention relates to a surface laser diode package having a monitor diode for monitoring an optical power of a surface laser diode.

A general optical disc system such as a compact disc player projects laser light on an information recording surface of a disc and reads information recorded on the disc. In this optical disc system, if an output of the laser light varies, an error may occur when a signal is read from the disc. Thus, the optical disc system includes an automatic laser power control (ALPC) servo circuit to stably control the output of the laser light. The ALPC servo circuit includes a photodiode for monitoring an optical power of a laser diode, and keeps a driving current of the laser diode constant according to the current flowing through the photodiode. Conventional surface laser diode packages will be described below with reference to Figures 1 and 2.

In the surface laser diode package of Figure 1, a monitor diode 15 has a cylindrical shape wrapping around a surface laser diode 12. The monitor diode 15 detects a spontaneous emission beam emitted from the lateral surface of the surface laser diode 12. The detected beam is used to monitor an optical power of the surface laser diode 12. If a current is applied to an electrode 11 of the surface laser diode 12, the current is supplied to an active region 13. If the current is supplied to the active region 13, the surface laser diode 12 generates a spontaneous emission beam. If the current supplied to the active region 13 is not less than a current value necessary for laser oscillation, the spontaneous emission beam generated from the active region 13 is transformed into a surface laser beam by the laser oscillation. The beam emitted from the active region 13 oscillates in an upper mirror 121 and a lower mirror 123, and is emitted outwards via the upper mirror 121 and absorbed into a substrate 14 via the lower mirror 123. The upper mirror 121 and the lower mirror 123 interposing the active region 13 are used as a resonator. A current density should be large to generate a surface laser beam. Thus, portions outside a laser oscillation area between the upper mirror 121 and the lower mirror 123 are processed by oxidation or proton implantation to form a high ohmic layer to thereby enlarge a current density.

The spontaneous emission beam generated by the active region 13 does not completely vanish and is minutely emitted in proportion to the optical power of the surface laser diode 12. The monitor diode 15 receives the spontaneous emission beam emitted from the sides of the surface laser diode 12 when current is applied to an electrode 16 of the monitor diode 15, and outputs a monitor current in proportion to the received beam.

However, the surface laser diode package of Figure 1 is poor in terms of temperature characteristic. Thus, if temperature varies, an accurate monitor current cannot be output. Also, a spontaneous emission beam is used instead of a surface laser beam, to thereby cause an

error in the optical power monitoring.

5 A surface laser diode package of Figure 2 has a structure where a monitor diode 15 is installed on a surface laser diode 12. The monitor diode 15 detects part of a surface laser beam emitted from the surface laser diode 12 when current is applied to an electrode 16 of the monitor diode 15. The detected beam is used for monitoring an optical power of the surface laser diode 12.

10 However, since the monitor diode 15 detects the spontaneous emission beam as well as the surface laser beam emitted from the surface laser diode 12, an error has occurred in the optical power monitoring. In addition, since the surface laser beam emitted to the external is used, the optical power of the surface laser diode 12 is lost and the manufacturing process becomes complicated.

15 With a view to solving or reducing the above problems, it is an aim of embodiments of the present invention to provide a surface laser diode package capable of monitoring an optical power by detecting a surface laser beam except a spontaneous emission beam among beams emitted toward a substrate via a lower mirror of a surface laser diode.

20 According to an aspect of the present invention, there is provided a surface laser diode package having an optical power monitoring function for a surface laser beam, the surface laser diode package comprising: a substrate; a surface laser diode for making a spontaneous emission beam generated from an active region oscillate by means of an upper mirror and a lower mirror, and emitting a surface laser beam obtained by the oscillation; and a monitor diode, installed between the substrate and the lower mirror of the surface laser diode, for performing a light detection operation with respect to the surface laser beam emitted toward the substrate via the lower mirror, in order to monitor the optical power of the surface laser diode.

25 30 35 40 45 According to another aspect of the present invention, there is provided a surface laser diode package having an optical power monitoring function for a surface laser beam, the surface laser diode package comprising: a substrate; a surface laser diode for making a spontaneous emission beam generated from an active region oscillate by means of an upper mirror and a lower mirror, and emitting a surface laser beam obtained by the oscillation; and a monitor diode, installed between the substrate and the lower mirror of the surface laser diode, for performing a light detection operation with respect to the surface laser beam emitted toward the substrate via the lower mirror, in order to monitor the optical power of the surface laser diode.

Preferably, the package comprises a light scattering portion, installed on a junction surface of said monitor diode and the lower mirror of said surface laser diode, for scattering the spontaneous emission beam incident via said lower mirror.

Preferably, said light scattering portion is installed on a region outside of a portion of said lower mirror corresponding to the surface from which the surface beam of said upper mirror is emitted.

Preferably, said light scattering portion is processed by oxidation.

50 55 For a better understanding of the invention, and to show how embodiments of the same may be carried into effect, reference will now be made, by way of example, to the accompanying diagrammatic drawings, in which:

Figures 1 and 2 shows the structures of conventional surface laser diode packages; and

Figure 3 shows the structure of a surface laser di-

ode package according to a preferred embodiment of the present invention.

A preferred embodiment of the present invention will be described with reference to the accompanying Figure 3.

Referring to Figure 3, the present invention uses the fact that light emitted from an active region of a surface laser diode package is emitted in both the directions of an upper mirror and a lower mirror.

In the surface laser diode package of Figure 3, a monitor diode 15 performs a light detection operation with respect to a laser beam emitted toward a substrate 14 via a lower mirror 123 of the surface laser diode 12. In more detail, the monitor diode 15 is installed on a junction surface of a P-type substrate 14 and an N-type lower mirror 123 of the surface laser diode 12, and performs a light detection operation with respect to the beam emitted via the lower mirror 123. The monitor diode 15 generates a monitor current in proportion to the intensity of the incident laser beam. A reference numeral 16 represents the electrode of the monitor diode 15.

Spontaneous emission beams generated by the active region 13 are randomly emitted in various directions, part of which oscillates by the upper mirror 121 and the lower mirror 123. The spontaneous emission beam which do not oscillate by the mirrors 121 and 123 causes incorrect monitoring of the optical power of the surface laser diode 12. A light scattering portion 30 is used to avoid the detection of the spontaneous emission beam. The light scattering portion 30 is formed by an oxidation process and is installed on the surface of the lower mirror 123 except a portion from which the surface laser beam is emitted. The spontaneous emission beam incident to the light scattering portion 30 is scattered therefrom. As a result, most of the spontaneous emission beam which do not oscillate is scattered by the light scattering portion 30 constituted by the oxidation processed layer.

The surface laser beam generated by the surface laser diode 12 is incident to the monitor diode 15 via a portion where the light scattering portion 30 is absent. In this case, a little spontaneous emission beam is incident to the monitor diode 15 via the portion where the light scattering portion 30 is absent. However, since the incident spontaneous emission beam has very little intensity, the monitor current generated according to the optical power of the surface laser beam does not change. Thus, the monitor diode can output the monitor current which is proportional to the optical power of the surface laser diode 12.

As described above, the surface laser diode package having an optical power monitoring function can monitor an optical power of the surface laser diode with more accuracy.

While only certain embodiments of the invention have been specifically described herein, it will be apparent that numerous modifications may be made thereto

without departing from the scope of the invention.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiment(s). The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

### 30 Claims

1. A surface laser diode package having an optical power monitoring function for a surface laser beam, the surface laser diode package comprising:

35 a substrate (14):

a surface laser diode (12) for making a spontaneous emission beam generated from an active region oscillate by means of an upper mirror (121) and a lower mirror (123), and emitting a surface laser beam obtained by the oscillation; and

40 45 a monitor diode (15), installed between said substrate (14) and the lower mirror (123) of said surface laser diode (12), for performing a light detection operation with respect to the surface laser beam emitted toward said substrate (14) via the lower mirror (123), in order to monitor the optical power of said surface laser diode (12).

50 55 2. The surface laser diode package according to claim 1, further comprising a light scattering portion (30), installed on a junction surface of said monitor diode (15) and the lower mirror (123) of said surface laser diode (12), for scattering the spontaneous emission

beam incident via said lower mirror.

3. The surface laser diode package according to claim 2, wherein said light scattering portion is installed on a region outside of a portion of said lower mirror (123) corresponding to the surface from which the surface beam of said upper mirror (121) is emitted. 5
4. The surface laser diode package according to any of the preceding claims, wherein said light scattering portion (30) is processed by oxidation. 10

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FIG. 1  
(PRIOR ART)

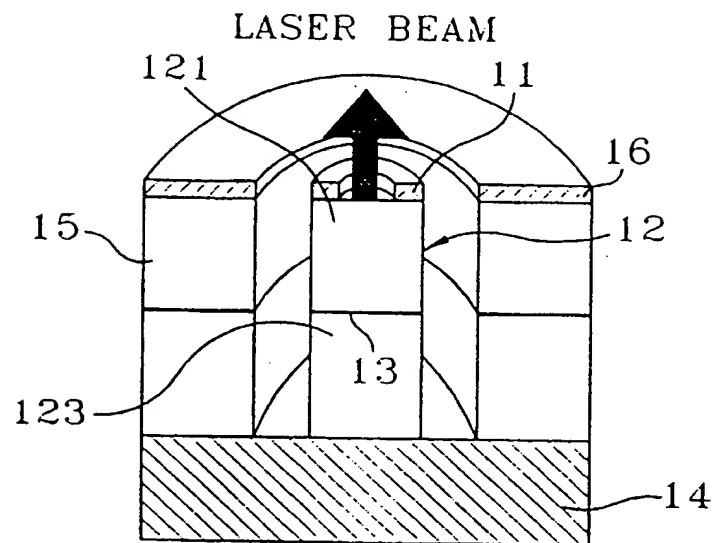


FIG. 2  
(PRIOR ART)

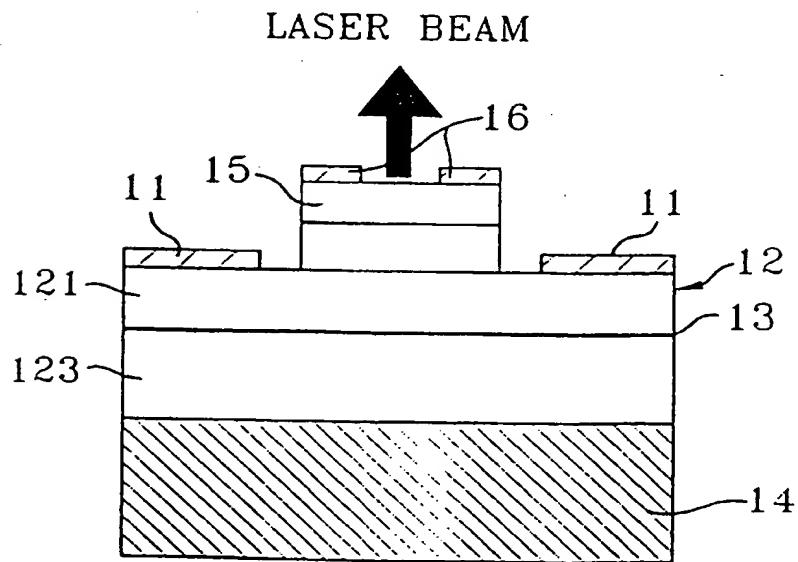
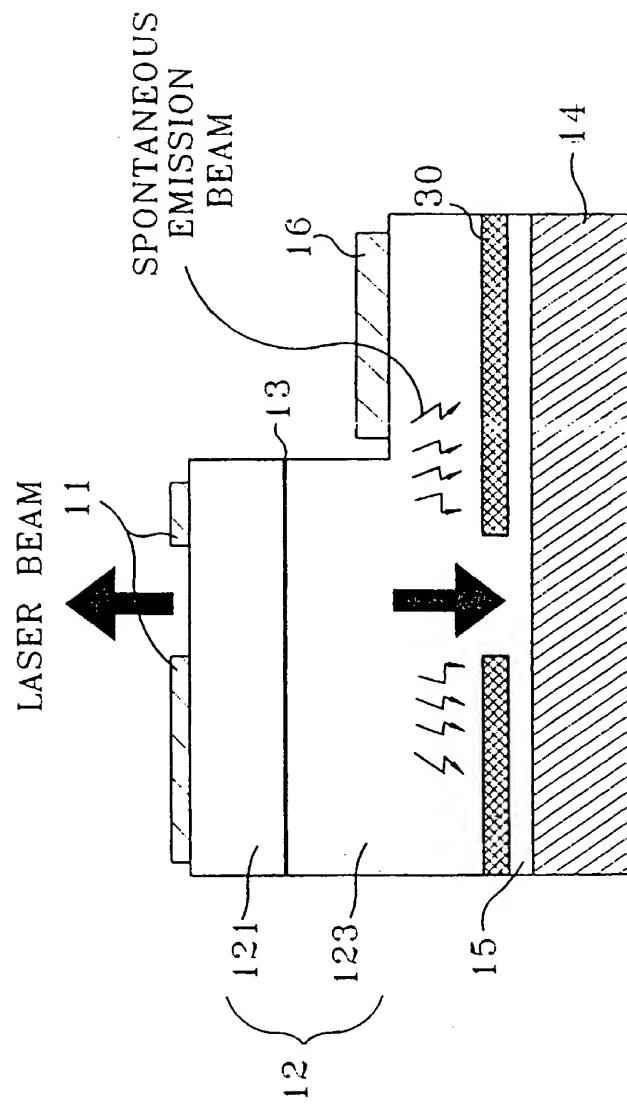
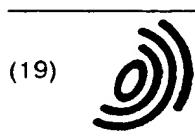


FIG. 3





(12)

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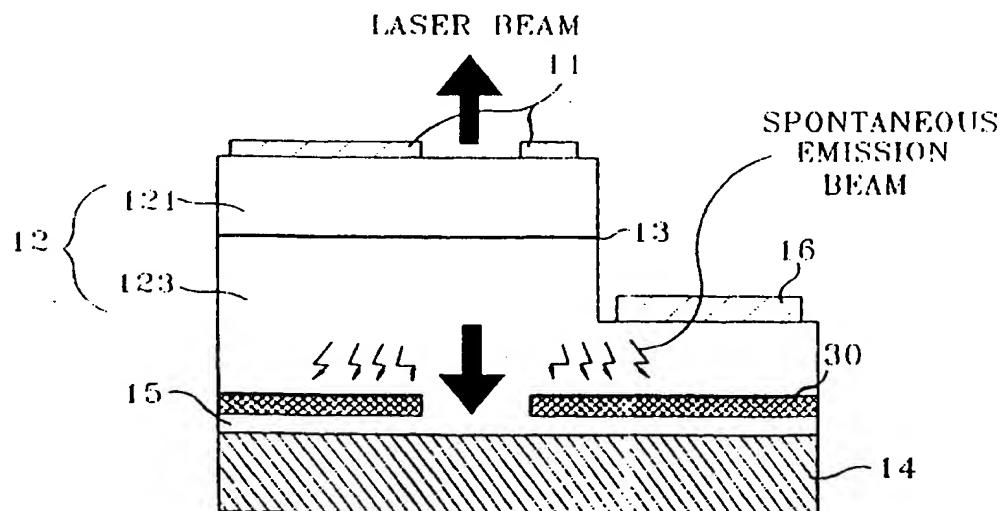
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FIG. 3





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## EUROPEAN SEARCH REPORT

Application Number  
EP 97 30 2521

## DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Creation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
X	WO 95 18479 A (HONEYWELL INC) * the whole document *	1	H01S3/025 H01S3/085
X	T.KIM ET AL.: "A single transverse mode operation of top surface emitting laser diode with a integrated photo-diode" CONFERENCE PROCEEDINGS OF THE 38TH ANNUAL MEETING OF THE IEEE LASERS AND ELECTRO-OPTICS SOCIETY (LEOS) vol. 2, 30 October 1995, pages 416-417. XP002057227	1	
A	* the whole document *	1-2-4	
A	FATENT ABSTRACTS OF JAPAN vol. 018, no. 359 (F-1574), 6 July 1994 -& JP 06 097597 A (TOSHIBA CORP), 5 April 1994. * abstract *	1-4	
A	HAYASHI Y ET AL: "Record low-threshold index-guided InGaAs/GaAlAs vertical-cavity surface-emitting laser with a native oxide confinement structure" ELECTRONICS LETTERS, vol. 31, no. 7, 30 March 1995, pages 560-562. XP000504313 * page 561, left-hand column; figure 1 *	2-4	

TECHNICAL FIELDS  
SEARCHED (Int.Cl.6)

H01S

The present search report has been drawn up for and aims

Place of search	Date of filing of the application	Examiner
THE HAGUE	27 February 1998	Stang, I
CATEGORY OF CITED DOCUMENTS		
<input checked="" type="checkbox"/> prior art, relevant and taken alone <input checked="" type="checkbox"/> particularly relevant & combined with another document of the same category <input checked="" type="checkbox"/> technical background <input checked="" type="checkbox"/> with another document <input checked="" type="checkbox"/> intermediate document		
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